At a Glance

What is it?

■ Computationally instantiated theory of the entire cognitive system—including perception, cognition, learning and action—constrained by computational, neural and psychological findings

■ Neurocognitive architectures instantiate predictive models of human performance across a wide variety of naval-relevant task domains.

■ Current research foci involve extending cognitive architectures with communicative abilities capable of robust dialogue with human counterparts as well as outfitting architectures with sophisticated attention and memory mechanisms.

How does it work?

■ Cognitive architectures consist of data structures, processing and connectivity assumptions as well as functionality corresponding to the mental representations and processes investigated by psychologists and neuroscientists. These architectures are either programmed using a formal language which manipulates these data structures or by neural systems
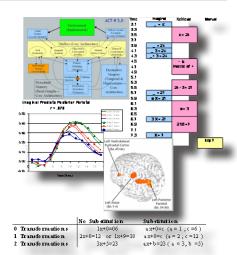
What will it accomplish?

■ Advances in neurocognitive architectures will enable the construction of autonomous systems that are capable of reasoning about actions faced with adversaries that perceive and act in a dynamic battlespace. This science will enable ever-higher fidelity computational models of individual warfighters.

Point of Contact

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The Office of Naval Research has invested in cognitive architectures for more than 20 years, achieving many successes. Most notably, cognitive architectures have been broadly applied to training and education in the development of intelligent tutoring technologies used at Department of Defense-dependent schools. Additionally, validated cognitive models of naval operator performance are currently being applied to human-to-computer interface issues as a cost-effective technique for exploring new concepts in naval displays.

The ADR system has been transitioned by Navy Facilities Engineering Logistics Center into the Seabee Table of Allowance and now available to Seabee for purchase for deployment needs.

Neurocognitive architectures comprise a particular class of integrated intelligent system whose software architecture is strongly constrained by findings in cognitive psychology and neuroscience. Such architectures typically embody a fully developed theory of human cognition, encompassing the integration of perception, cognition and action.

The development of truly intelligent machines will have an enormous impact on the way war is conducted. An immediate impact involves the removal of the human warfighter from harm's way whenever possible. This science could lead to the development of seamless human-to-machine interfaces where the machine tracks the beliefs, desires, etc., of the human user, and adapts its functions accordingly to act as an effective collaborator.

Research Challenges and Opportunities:

• Representation of mental states within cognitive architectures: This includes pragmatic phenomena in language requiring mental-state reasoning; intention recognition beyond activity recognition; and generation and maintenance of dynamic goal structures.

• Integration and inference frameworks for neuro-symbolic systems: This includes new architectural concepts supporting both symbolic and connectionist computation; top-down influences of structured knowledge on bottom-up attention processes; and hybrid reactive/deliberative architectures.

• Event representation, episodic memory and consolidation including: This includes neuropsychological models of the prefrontal cortex; models of reconstructive memory and context-linking in the consolidation process; and large-scale memory management through consolidation.

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